$$\therefore \triangle = x^2 \cos^{-1}\left(\frac{x^2+a^2-r^2}{2\,a\,x}\right) + r^2\cos^{-1}\left(\frac{a^2+r^2-x^2}{2\,a\,r}\right) - a\sqrt{r^2-\left(\frac{a^2+r^2-x^2}{2\,a}\right)^2}.$$

When $x = R$,

$$\triangle = R^2 \cos^{-1}\left(\frac{a^2-r^2+R^2}{2\,a\,R}\right) + r^2\cos^{-1}\left(\frac{a^2+r^2-R^2}{2\,a\,r}\right)$$
$$-a\sqrt{r^2-\left(\frac{a^2+r^2-R^2}{2\,a}\right)^2},$$

which agrees with the result obtained by the ordinary method.

The above formula may be readily adapted to any special case.

When the center P is on the circumference of the other circle, $a = r$, and

$$\triangle = R^2\cos^{-1}\left(\frac{R}{2\,r}\right) + 2\,r^2 \sin^{-1}\left(\frac{R}{2\,r}\right) - \tfrac{1}{2}R\sqrt{4\,r^2 - R^2}.$$

If the circles are equal, $R = r$ and

$$\triangle = 2\,r^2 \cos^{-1}\left(\frac{a}{2r}\right) - \tfrac{1}{2}a\sqrt{4\,r^2 - a^2}.$$

When they are equal and the center of one on the circumference of the other, $R = r$, $a = r$ and

$$\triangle = r^2\left(\frac{2}{3}\pi - \frac{1}{2}\sqrt{3}\right).$$

PROBLEMS.

5. In a plane triangle there are given the three lines bisecting the angles, a, b and c, to find the sides.—Communicated by Dr. David S. Hart, Stonington. Conn.

6. Find a convenient formula for calculating the capacity of a cistern constructed as follows, viz: Having a lower concavity which is a spherical segment whose versed sine is a and chord $2\,r$, a central cylindrical part whose radius is r and perpendicular height h, and an upper concavity which is a spherical segment whose versed sine is b and chord $2\,r$.—Communicated by Frank Pelton, C. E., Des Moines, Iowa.

7. Multiply $\sqrt[3]{1 + \sqrt[3]{1 + \sqrt[3]{1 + \&c.}}}$ by $\sqrt{1 + \cfrac{1}{\sqrt{1 + \cfrac{1}{\sqrt{1 + \&c.}}}}}$

and express the product in a finite number of terms.—Communicated by Prof. Daniel Kirkwood, Bloomington, Ind.

8. A ball *rolls* down the convex surface of a fixed sphere, the friction* being just sufficient to prevent sliding; find the point where it leaves the sphere.—Communicated by ARTEMAS MARTIN, Mathematical Editor of *Schoolday Magazine*, Erie, Pa.

9. P and Q denoting two entire functions o x, such that we have $\sqrt{1-P^2} = Q\sqrt{1-x^2}$, we have necessarily

$$\frac{dP}{\sqrt{1-P^2}} = n\frac{dx}{\sqrt{1-x^2}};$$

n denoting an entire number.—Communicated by PROF. HALL, Washington, D. C.

10. The chief justice of a court makes a large number of legal decisions. Afterward it is found that 50 per cent of these decisions are erroneous. Required to determine the legal knowledge of the judge.—Communicated by PROF. HALL.

EDITORIAL NOTES.

In presenting this, the second number, to our readers we hope it will be found to be something of an improvement on the first. We do not intend to use up our space in apologizing for past delinquencies, or in promises of future improvement, but we hope to learn from experience, and profit by the advice and criticisms of our correspondents.

A very considerable number of typographical errors occur in our first number. Some of these we noticed, but too late to remove them, and others have been pointed out by our correspondents. As all the errors that have been noticed are unimportant and cannot mislead any of our readers, we will allow each reader to correct them for himself; and we will here remark that, in the future, though we will use as much care as we can command to avoid typographical errors, and will, when *material*, if noticed or pointed out to us, subsequently insert the correction; but all immaterial errors, that is, all such as cannot mislead the reader, we will pass in silence; though we will be thankful to have our attention called to them, so that we can guard against similar errors in

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*If in this question the proper substitutions be made from the equations of motion as given in any standard work on Mechanics, *Bartlett's* for instance, it is found that the ball will quit the sphere at the moment when it has descended through seven-seventeenths of the radius of the sphere, supposing it to have started from the summit. But on the supposition that it *slides* down the sphere without friction, then it would quit the sphere when it has descended through one-third the radius.

Prof. Peck says, however, that "If a body be placed on an inclined plane and abandoned to the action of its own weight it will either slide or roll down the plane, provided there be no friction between it and the plane. If the body is spherical it will roll, and in this case the friction may be disregarded . . . . and equations (67) and (68) will be immediately applicable." [See Peck's Mechanics, p. 158.]

Will correspondents explain this apparent discrepancy.—ED.